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ABSTRACT

Sixty-five learning disabled (LD), educable mentally retarded (EMR), and normal second graders were compared on their ability to profit from instruction on a balance scale task and on their ability to transfer their learning to two new tasks. During individual training, the retarded group required an average of 9.8 hints, the LD group an average of 9.3, and the normal group an average of 6.8 hints. Differences on the transfer task were significant between the EMR and normal Ss and approached significance between the EMR and LD Ss. Two groups of children did not exhibit consistent learning/transfer profiles: Ss who learned quickly but did not transfer well (context bound); and Ss who learned slowly but were able to transfer well (reflective). The authors concluded that measures of the ability to transfer information appears to be the most sensitive indicator of differences between LD and EMR children. (CL)

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A Comparison of the Zone of Proximal Development in Learning Disabled, Mentally Retarded, and Normal Children

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Paper presented at the 1982 Meeting of the American Educational Research Association, March 19-23, 1982, New York.

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Traditional IQ tests have been shown to be inadequate for providing early identification of children with learning problems. Specifically, these static, standardized testing methods have been criticized for their inability to diagnose children with learning disabilities or mildly retarded children prior to the child's experience of school failure (Brown & French, 1979). Brown and French and others (Brown & Ferrara, 1980; Brown & French, 1979; Campione, Brown, & Ferrara, in press; Ferrara, Brown, & Campione, 1981; Wozniak, 1979) have suggested that dynamic testing methods may be more useful than static IQ tests because the dynamic measures examine the child's modifiability. Moreover, these researchers suggest that dynamic methods may provide a means to differentiate between mildly mentally retarded and learning disabled children at an early age.

Dynamic testing methods measure the improvement that a child may achieve via teacher/student interaction (e.g., Budoff, 1969; Feuerstein, 1979). Such improvement can best be discussed in terms of Vygotsky's concept of the zone of proximal development (Vygotsky, 1978). Vygotsky defined the zone as the distance between the actual developmental level and the potential developmental level. The actual developmental level is represented by the degree of problem solving the child can achieve without aid. Thus, most standardized tests attempt to measure a child's actual level of development. On the other hand, the potential level of development is represented by the degree of problem solving the child can achieve with assistance from an adult or more capable peer. Vygotsky

believed that the difference between what the child is able to do alone and what the child is able to do with assistance (i.e., the zone) is important because it defines mental functions that have not matured, but are in the process of maturing.

Previous studies of the zone (e.g., Brown & Ferrara, 1980) have employed two measures of zone width: 1) the number of hints or prompts the child requires in order to attain some criterion level of task mastery, and 2) the child's ability to transfer her or his learning to other tasks. Children with wider zones should require less adult assistance to achieve task mastery and to transfer their learning to structurally different problems.

Zone measures may provide useful information for differentiating between learning disabled and mildly retarded children. In fact, Soviet psychologists claim that given the same level of task competence, learning disabled children will display much wider zones than retarded children. That is, the learning disabled children will require less adult aid to master a task and to transfer that mastery than will mildly mentally retarded children (Brown & Ferrara, 1980; Wozniak, 1979). This claim has yet to be empirically verified.

In this study, learning disabled, educable mentally retarded, and normal second grade children were compared on their ability to profit from instruction on the balance scale task and on their ability to transfer their learning to two new tasks. The purpose of the study was twofold: First, we wanted to extend exploration of the zone to two new populations, children with learning disabilities and educable mentally retarded

children. Second, we wanted to study differences between zone measures in the three populations. We hypothesized that: 1) Mentally retarded children would display the most narrow zones. Thus, we expected the retarded subjects to require more adult assistance to learn to solve balance scale problems and to exhibit more difficulty in transfering their learning. 2) We did not expect differences in zone width between the normal and learning disabled groups. Thus, we expected normal and learning disabled subjects to require approximately the same amount of adult assistance to master balance scale problems and to transfer that mastery.

METHOD

Subjects

Sixty-five children from a public school system participated in the study. Of the participants, 40 children were selected as subjects based on two criteria: 1) Assurance from the child's teacher that the child was able to add sums up to 15, and 2) the child's performance on a pretest of balance scale problems. Thus, all subjects were approximately matched in terms of their initial understanding of the task. In Vygotsky's terminology, all subjects were approximately matched on their actual developmental level.

Materials

The balance scale was used as the main task because of the abundance of available information about it. Robert Siegler has provided an extensive task analysis of the scale, and we refer interested readers to his work (Klahr & Siegler, 1978; Siegler, 1976; 1979). The balance scale used had ten pegs on

either side of the fulcrum. The near transfer task, the Balance of Power game by Milton Bradley, was structurally quite similar to the training scale. The game consisted of nine small, connected balance scales. Each scale had three unnumbered spaces on either side of the fulcrum, and each of these spaces would hold one game piece. Thus, on both the training scale and the near transfer task, which arm would go down was determined by the arrangement of the weights.

The far transfer task, on the other hand, was structurally very different. The task was a doll sized teeter totter with a movable fulcrum. Dolls of three different weights and sizes "fit" the teeter totter, two at a time. When the teeter totter was set so that the fulcrum was at midpoint, it would balance only if two equal size dolls were placed on its arms. However, when dolls of unequal sizes were placed on the teeter totter, it would balance if the fulcrum were appropriately adjusted. Therefore, on the far transfer task, which arm would go down was determined by the location of the fulcrum. However, an understanding of the concept of torque was necessary for successful solution of all three tasks.

Procedure

Each subject worked individually with the experimenter on three separate occasions. In the first session, each of the sixty-five children participating was administered a balance scale pretest. Children who used Siegler's first rule to solve the problems were selected to continue in the study. Thus, all subjects were approximately matched on initial understanding of the task.

In the second session, each student was trained to solve balance scale problems according to an arithmetic strategy. Across several problems, the experimenter provided a series of increasingly explicit hints as needed by the child to guide him or her toward understanding the strategy. Paper and pencil were provided for the subject's use throughout the session. Training ended when the child could correctly solve three consecutive problems using the math strategy without adult assistance. All subjects attained use of the strategy during the training session and demonstrated that achievement on an immediate posttest at the end of the session.

The third session, which occurred approximately five days after the second, began with the administration of a posttest to measure strategy maintenance. Again, paper and pencil were available for the subject's use. Following the posttest, the near transfer task was administered. The child was presented with a series of problems on the Balance of Power game that were roughly analogous to those given during training. The experimenter provided a second series of hints as needed by the child to derive the correct solution.

For the final part of the third session, the far transfer task was administered. After demonstrating that a pair of equal weight dolls would balance on the teeter totter when the fulcrum was at midpoint, the instructor asked the child to balance the toy with a pair of dolls of unequal weights. The subject had to demonstrate an understanding of torque to solve these problems. The experimenter provided a third set of increasingly explicit hints as needed to facilitate and measure transfer.

RESULTS AND DISCUSSION[1]

Within each group, we computed the average number of hints required to train subjects to solve the balance scale. (Figure 1.) During training, the retarded group required an average of 9.8 hints, the learning disabled group required an average of 9.3 hints, and the normal group required an average of 6.8 hints. Thus, the means obtained did follow the predicted pattern, although they were not significantly different ($\chi^2_2 = 2.12$, $p \leq .34$).

On the transfer tasks, the predicted pattern became more pronounced, and the differences became significant. (See Figure 2.) Group differences on the mean number of hints provided approached significance on the near transfer task ($\chi^2_2 = 2.75$, $p \leq .25$). (See Figure 3.) On the far transfer task, the group differences were significant ($\chi^2_2 = 7.06$, $p \leq .02$). Further comparisons revealed that the difference between the EMR and normal subjects was significant ($\chi^2_1 = 7.00$, $p \leq .01$), and that the difference between the EMR and LD children approached significance ($\chi^2_1 = 1.75$, $p \leq .18$).

The median number of hints required for each task was calculated across groups so that each child could be characterized as a fast learner (i.e., one who required fewer than the median number of hints) or as a slow learner (i.e., one who required the median number of hints or more). Similarly, children were classified as high or low transferers. Thus, we derived a group measure that was less influenced by extreme individual

[1]Since the data collected were ordinal level scores, all results were analyzed using Kruskal Wallis analysis of variance by ranks.

scores. (See Figure 4.) This figure illustrates the proportion of children in each group classified as either high or low transferers on each transfer task. While group differences were not significant on the near transfer task, ($\chi^2_2 = .55$, $p \leq .75$), the far transfer task showed significant differences between both the EMR and normal groups ($\chi^2_1 = 6.43$, $p \leq .01$) and the EMR and LD groups ($\chi^2_1 = 3.99$, $p \leq .04$).

One other difference between the groups was in terms of maintenance demonstrated on the delayed posttest. (See Figure 5.) Although 90% of the learning disabled and 80% of the normal children demonstrated a high level of maintenance on the posttest, less than half of the retarded children appeared to retain most of their learning. Comparisons showed that the difference between the EMR and LD groups was significant ($\chi^2_1 = 3.81$, $p \leq .05$) as well as the difference between the EMR and normal groups ($\chi^2_1 = 3.67$, $p \leq .05$). Since maintenance is usually a prerequisite for successful transfer, we were concerned that these differences in maintenance would account for the differences obtained in transfer. However, this was not the case. (See Figure 6.) When we reanalyzed transfer differences including only high maintenance subjects, the predicted pattern of results was still obtained and approached significance ($\chi^2_2 = 3.76$, $p \leq .15$).

The training and transfer characteristics were combined in order to examine four profiles. As one would logically predict, three fourths of the children in this study appeared to be consistent in their ability to learn and to transfer learning to new tasks. That is, 75% of the subjects were either fast

learners and high transferers or else they were slow learners and low transferers. However, a significant number of children did not exhibit consistent learning/transfer profiles. Following Brown and Ferrara, these inconsistent children can be divided into two groups. Children who learn quickly, but do not transfer well are called context bound. In contrast, slow learners who are able to transfer well are labelled reflective.

The profiles were further studied within groups. (See Figure 7.) The majority of children in each group fall in consistently slow or consistently fast categories. Interesting differences occur, however, in the inconsistent profile categories. While none of the learning disabled children are labelled context bound, 33% of the retarded children fall in that category. In contrast, none of the retarded children are labelled reflective, while 20% of the learning disabled children demonstrate a reflective profile.

In this study, the two measures of zone width, learning speed and transfer ability, appear to be measuring different constructs. We offer two pieces of evidence to support this contention: 1) The existence of the inconsistent profiles in a large proportion of the subjects in this study and in the Brown and Ferrara study show that intraindividual differences are common on these measures, and 2) while learning speed does not differ in this context between normal, EMR, and LD groups, transfer measures do differ. Therefore, we conclude that measures of the ability to transfer information acquired on one task to other related tasks appears to be the most sensitive

indicator of differences between learning disabled and mildly retarded children.

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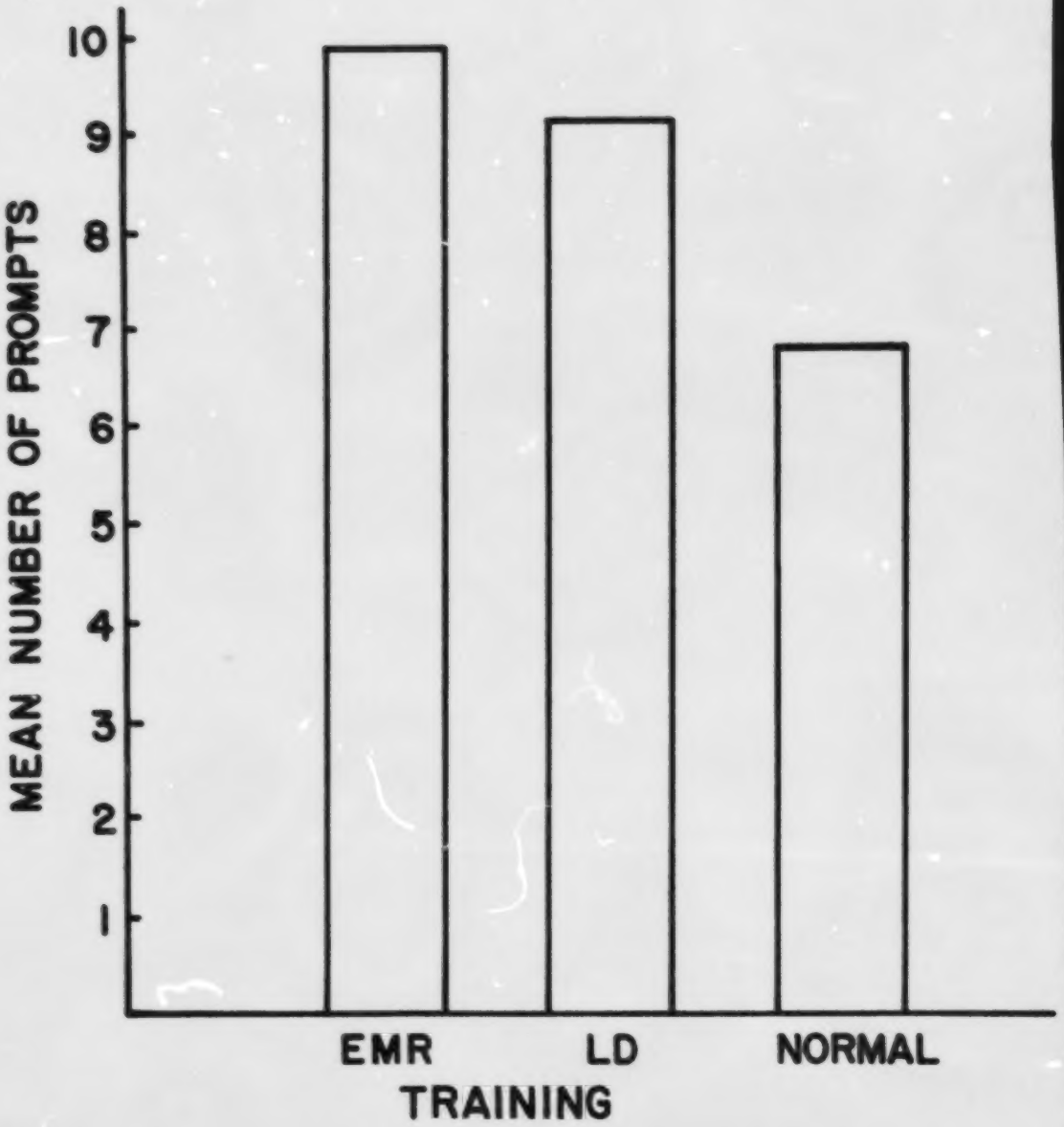
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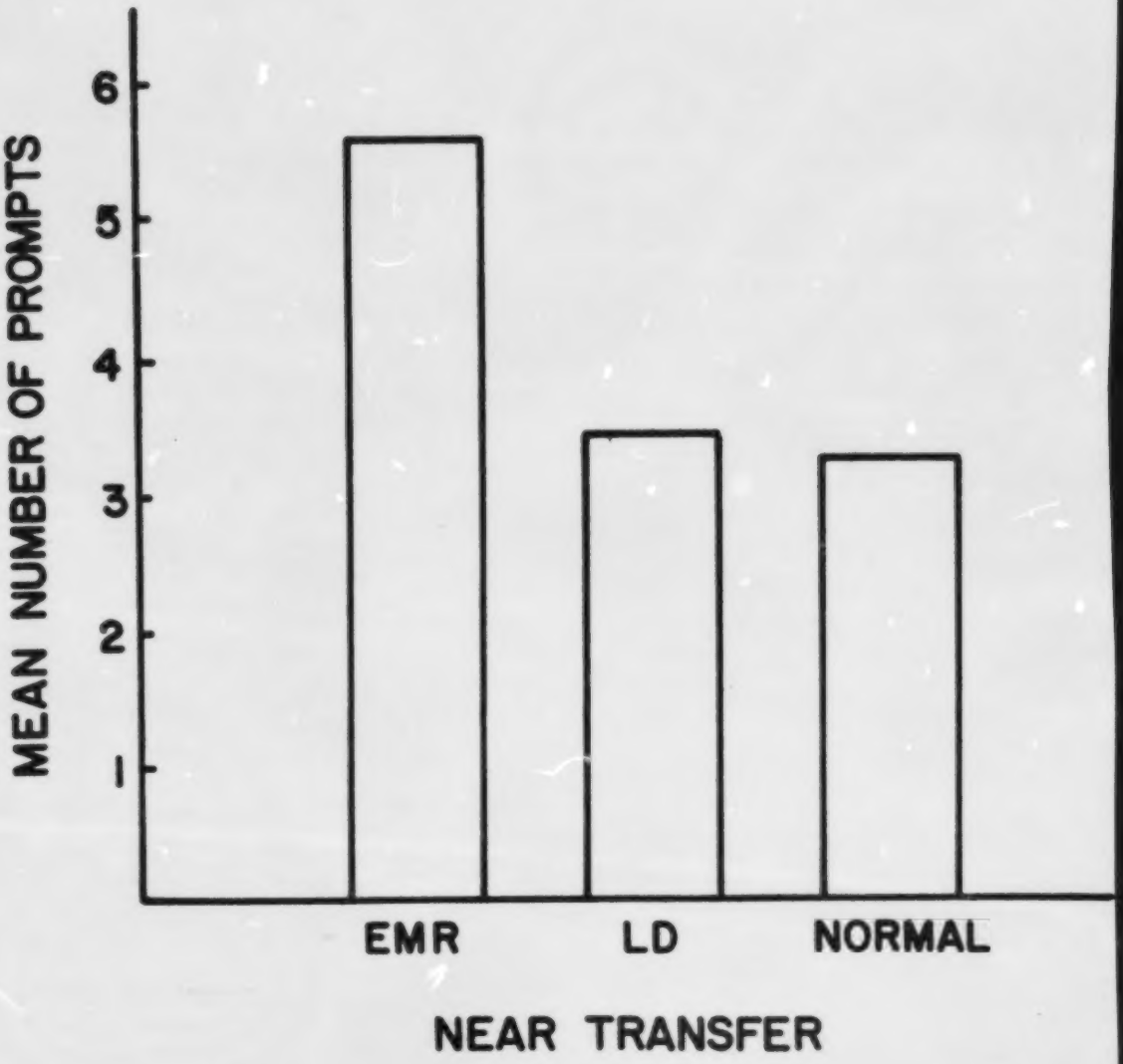
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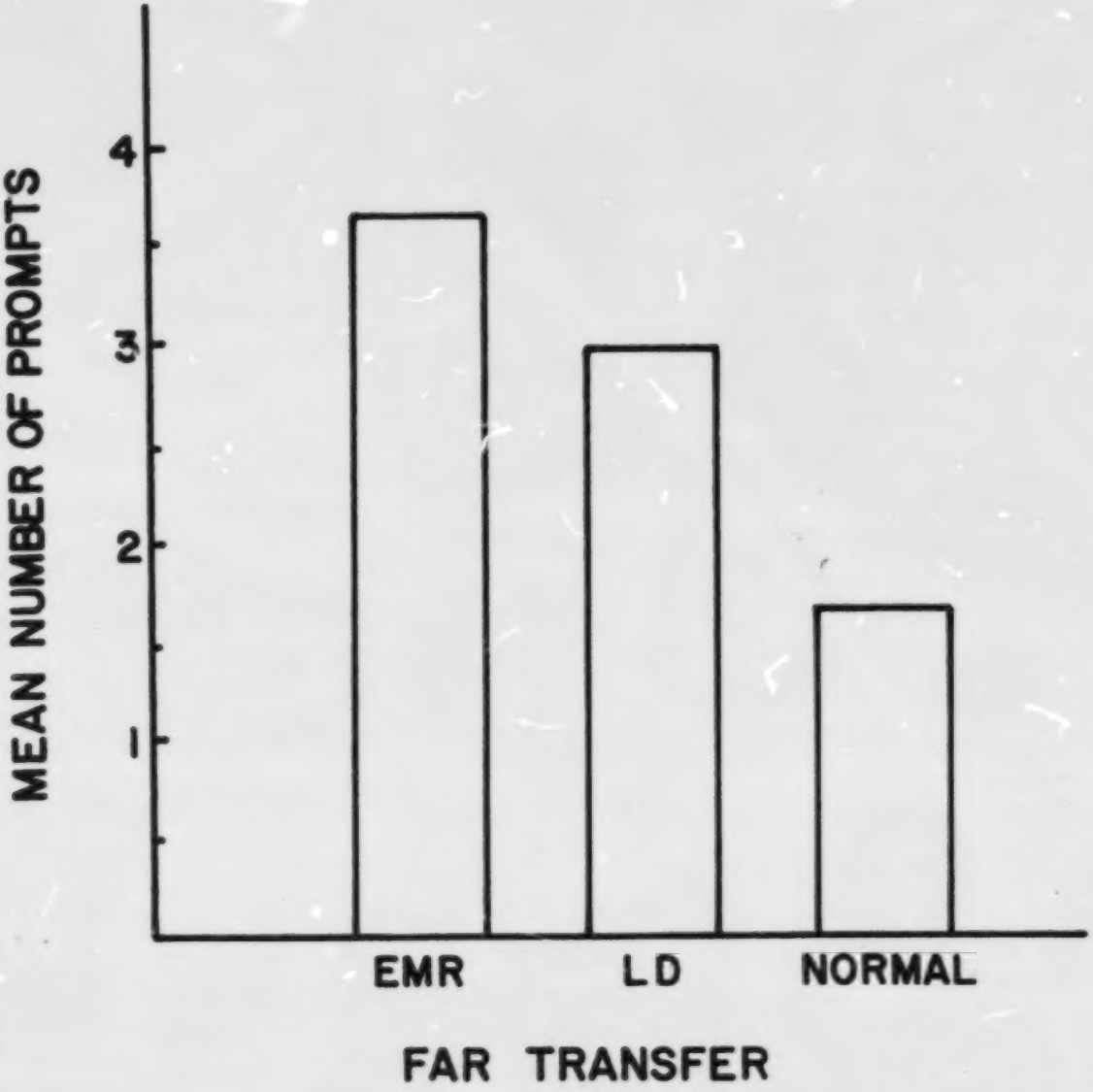
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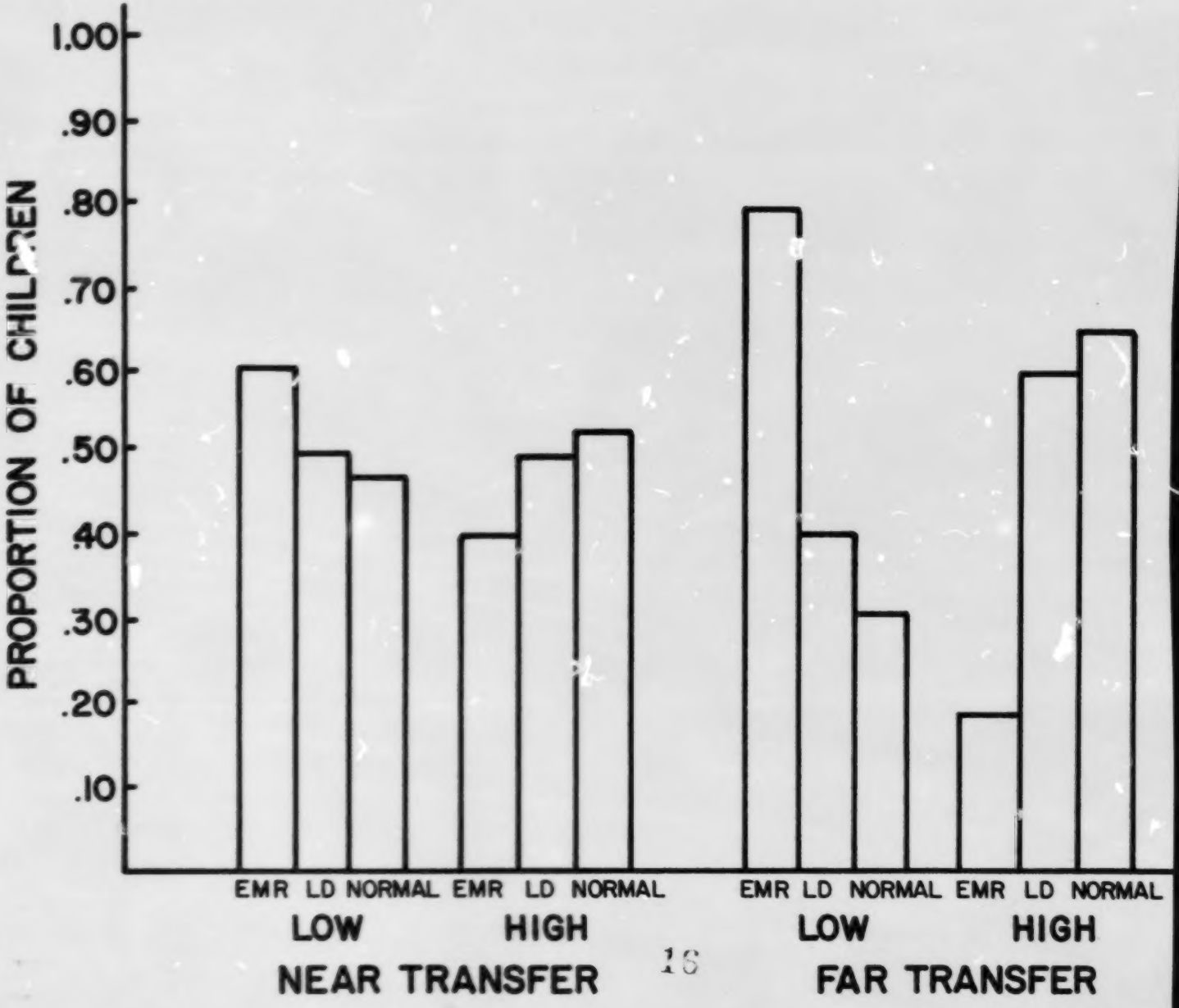
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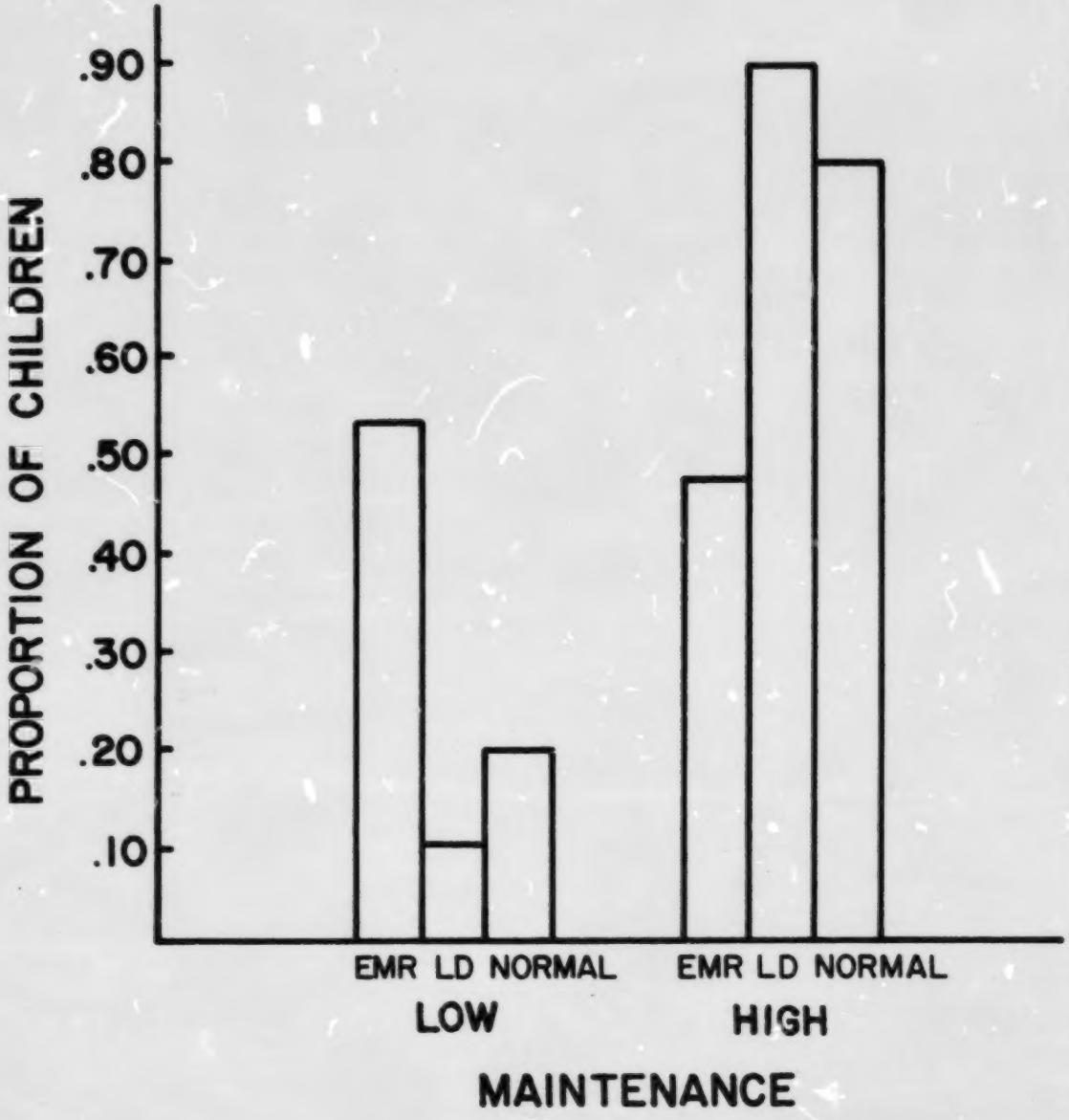
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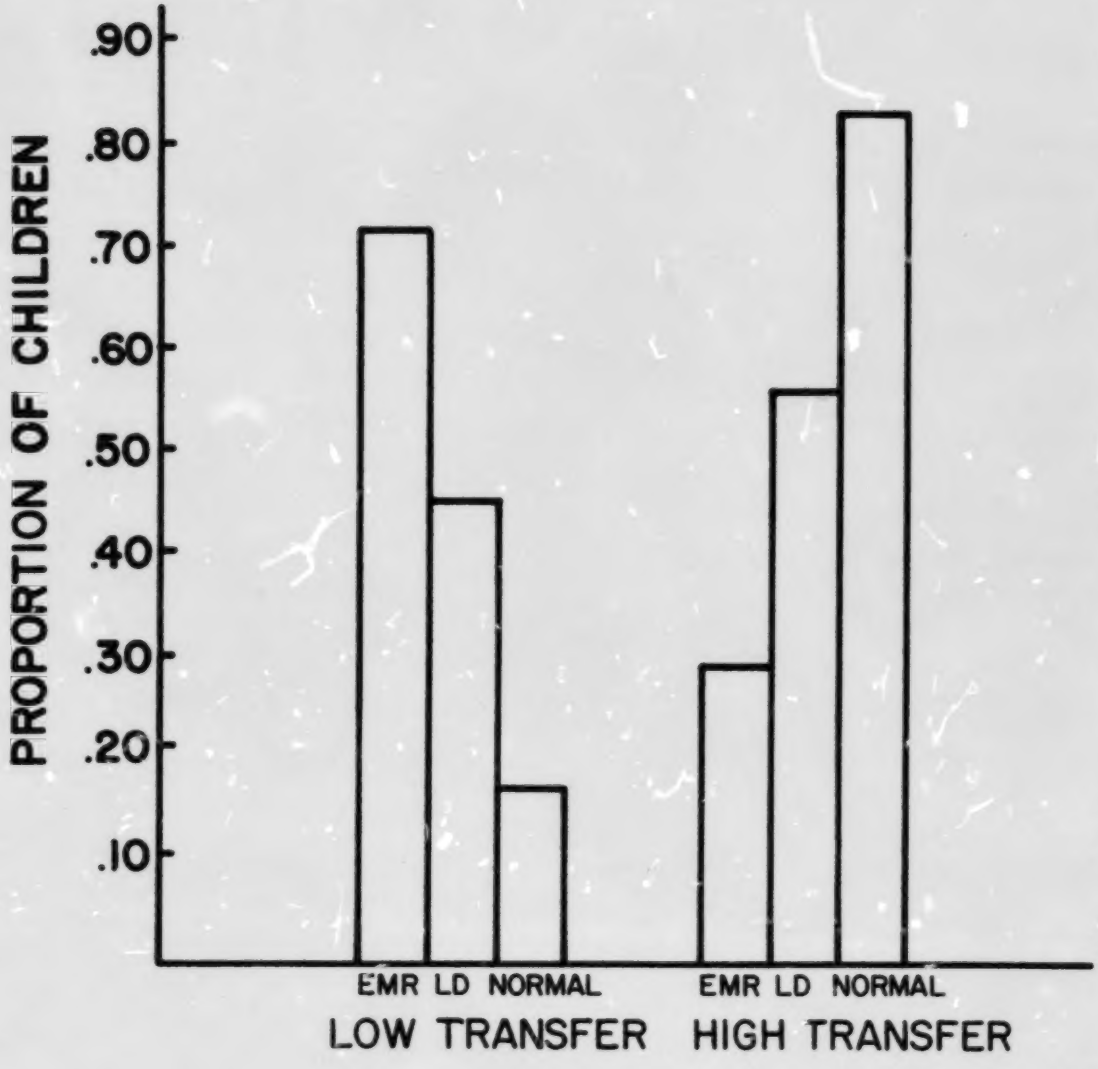

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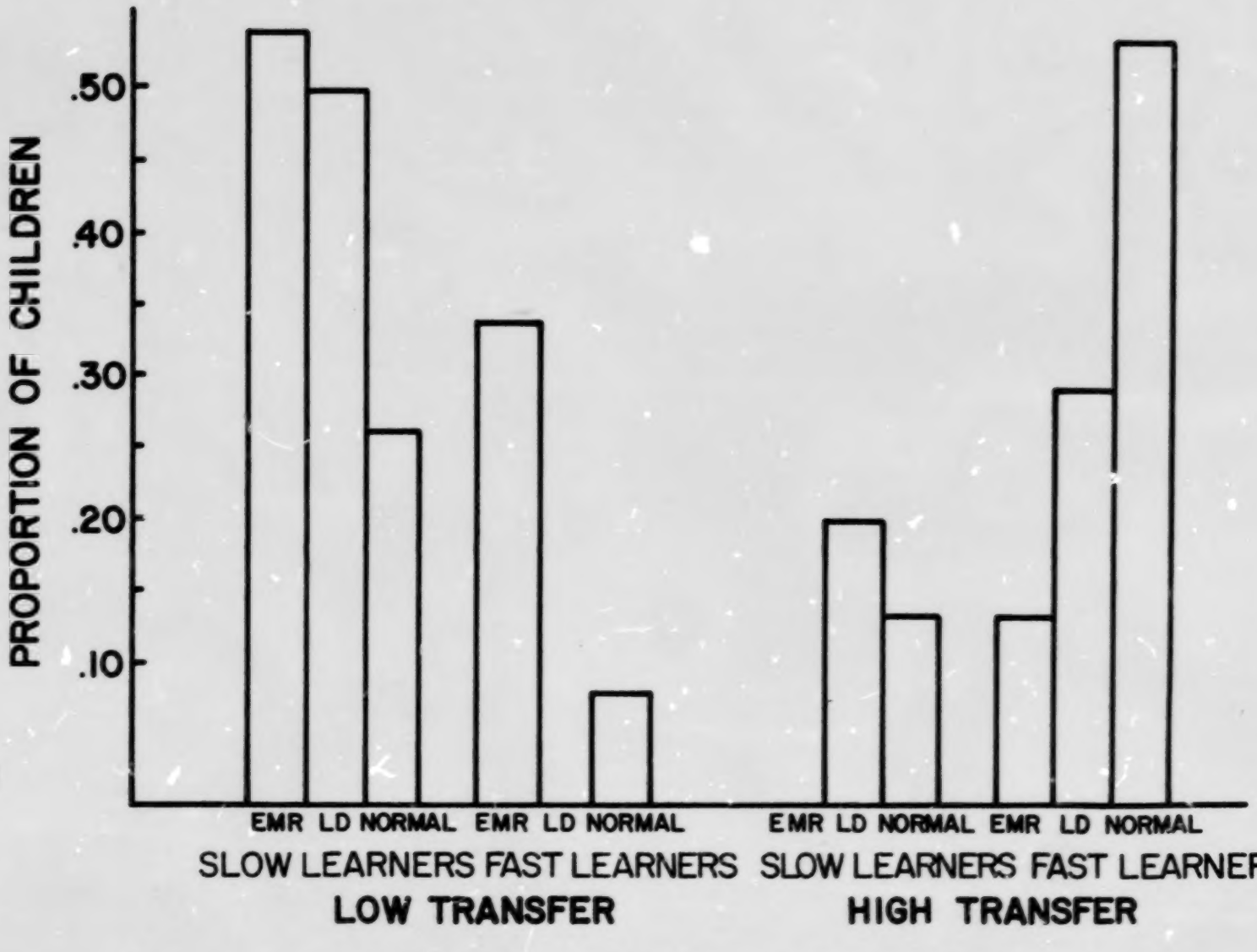

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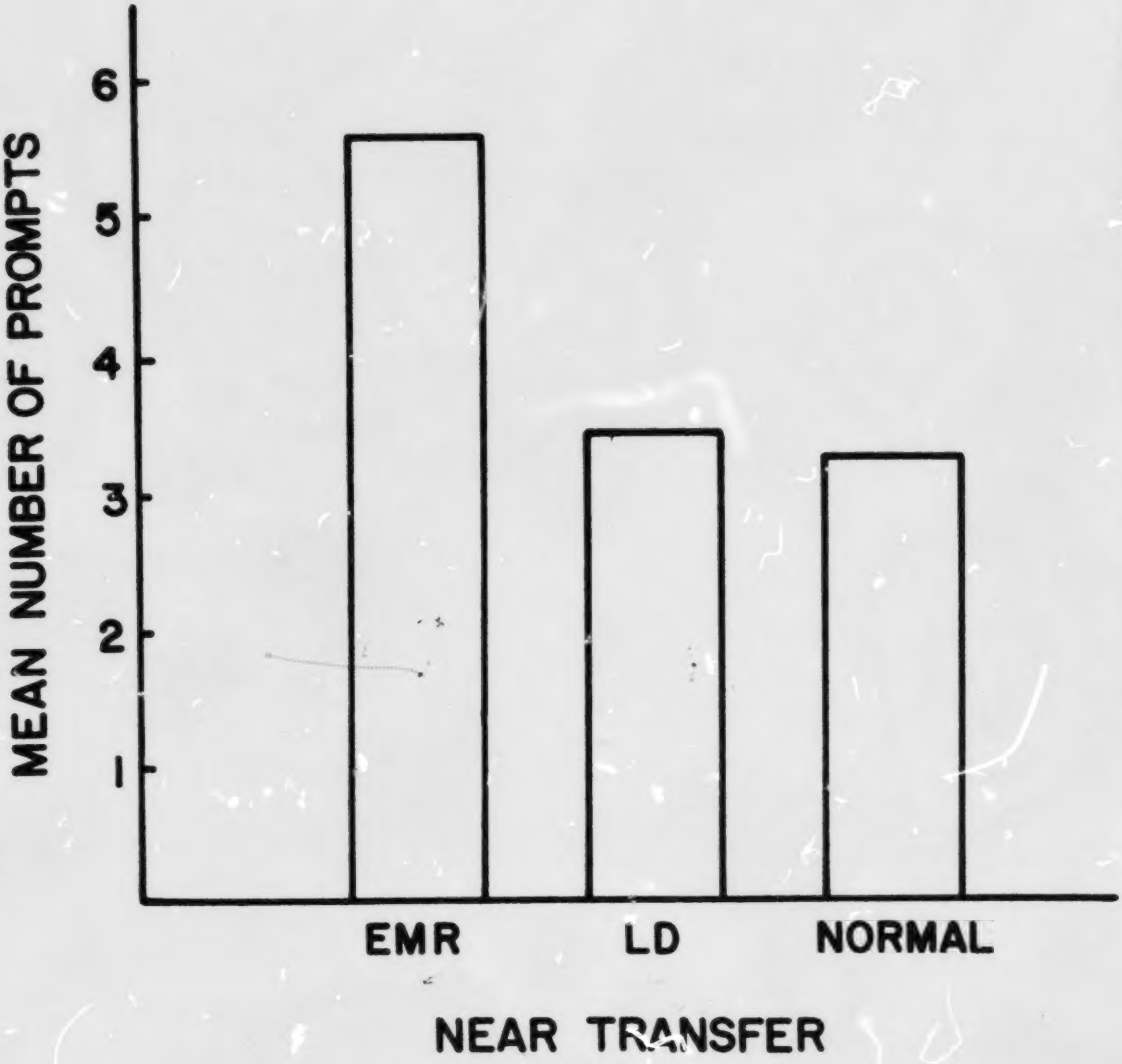
LEARNING/ TRANSFER PROFILES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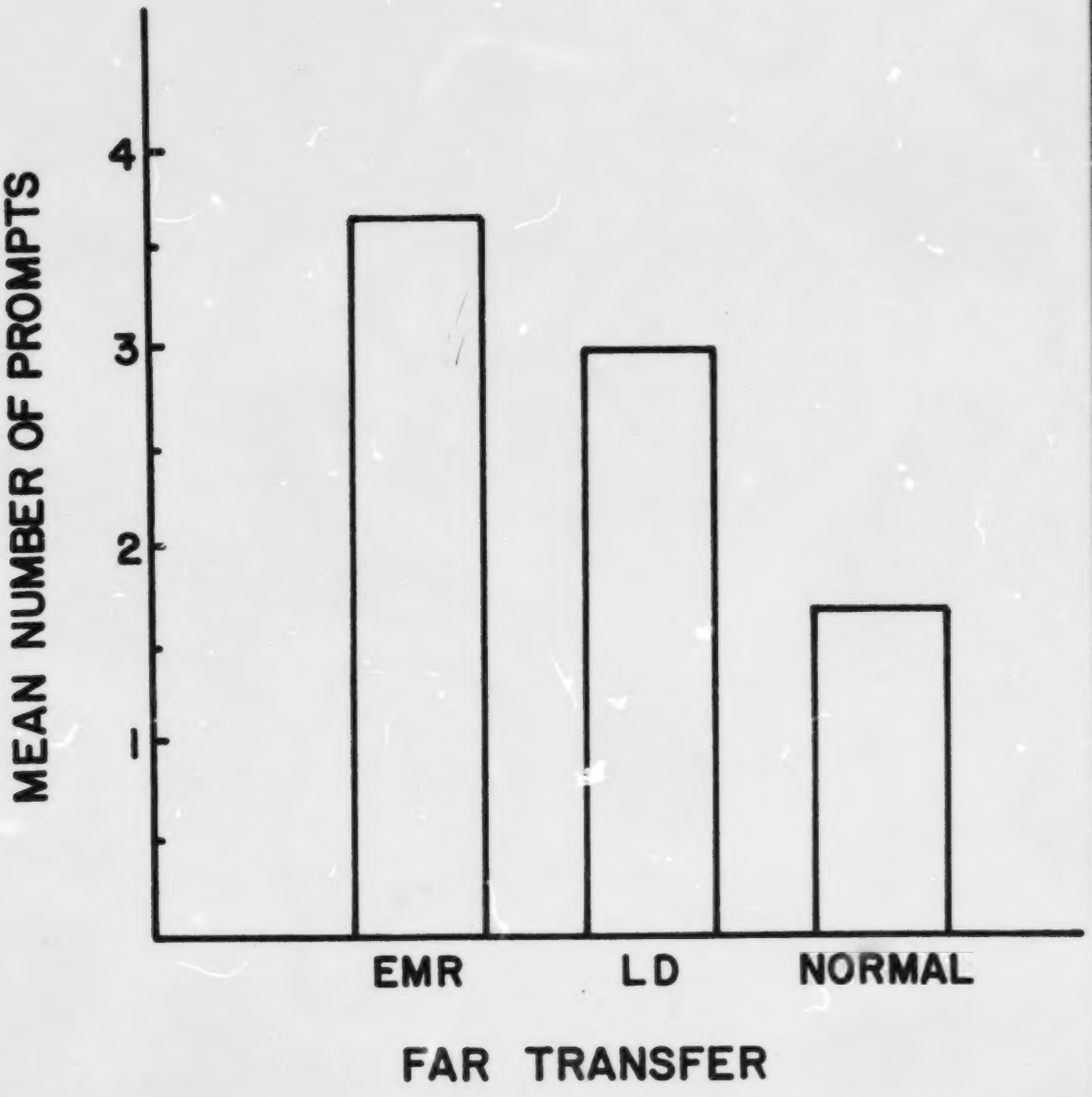
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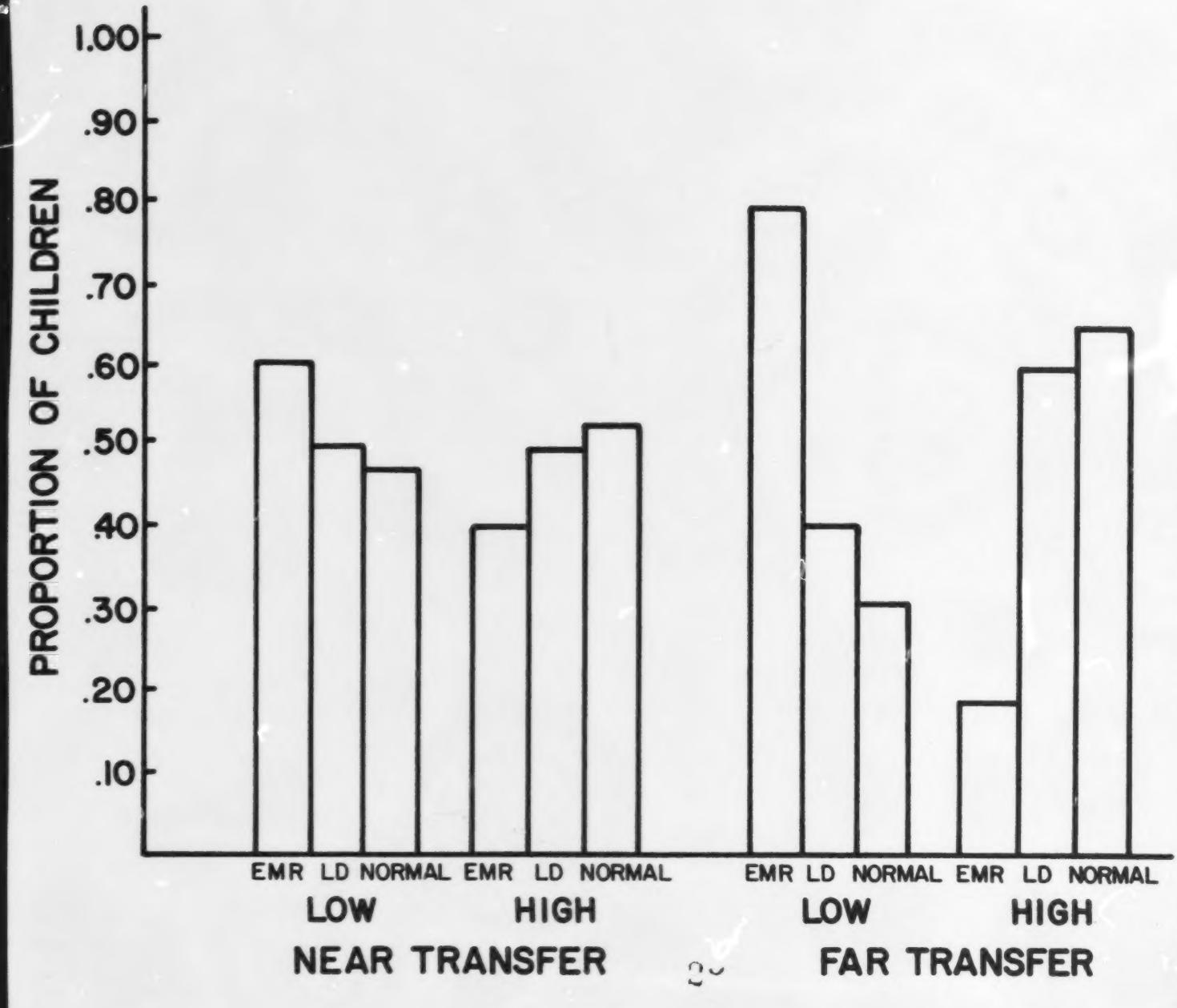
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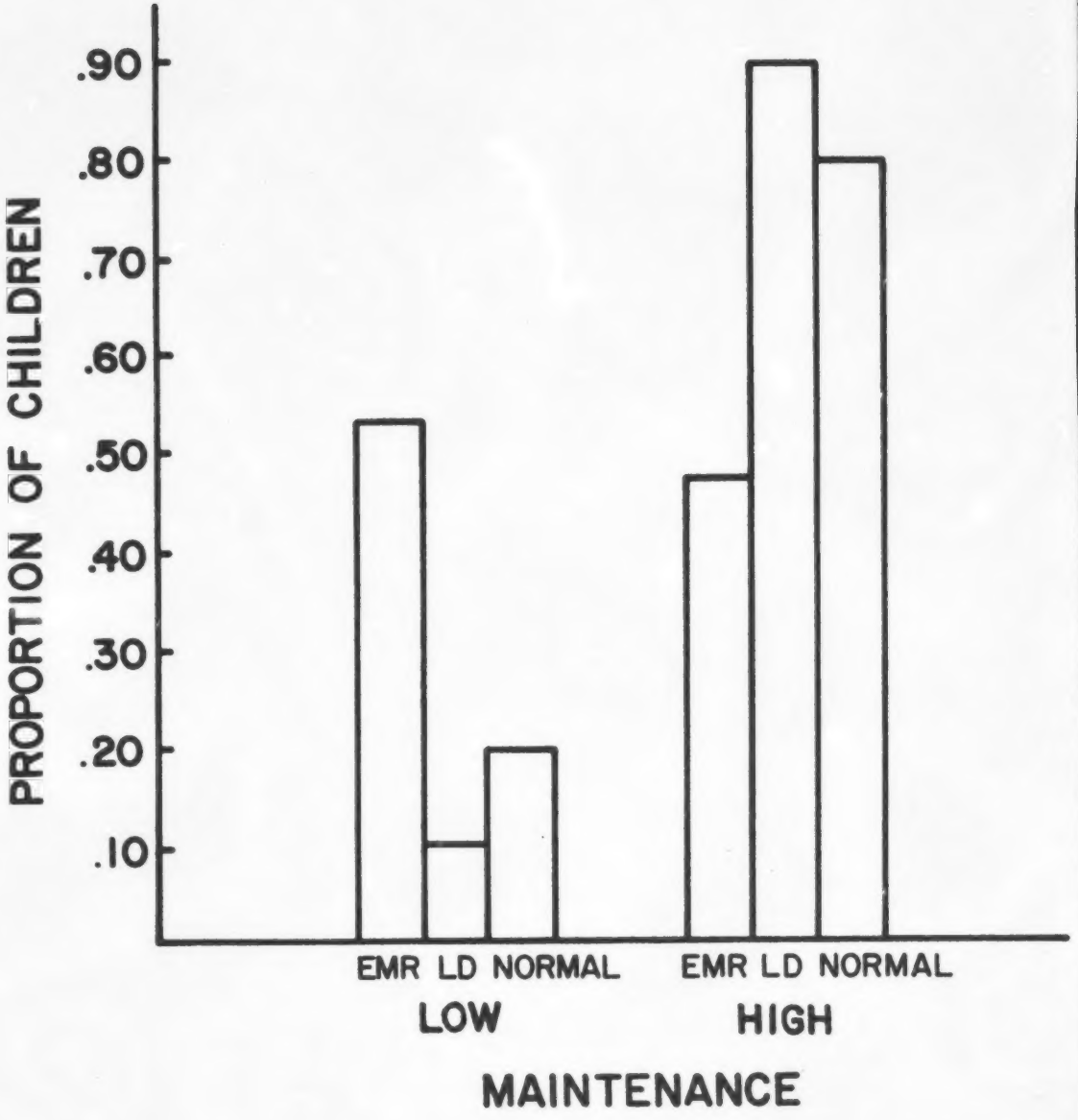
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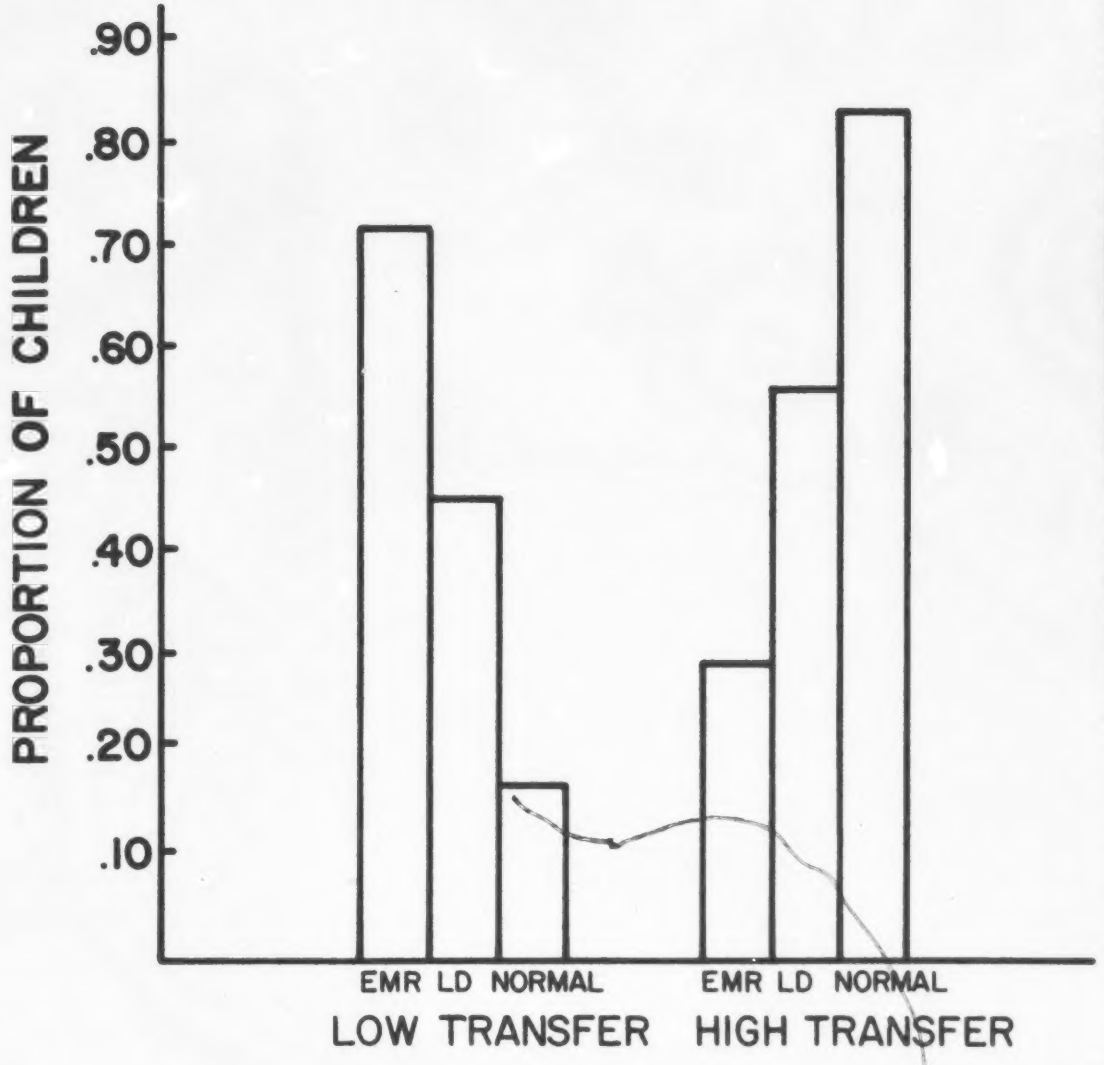

TRANSFER BY CHILDREN
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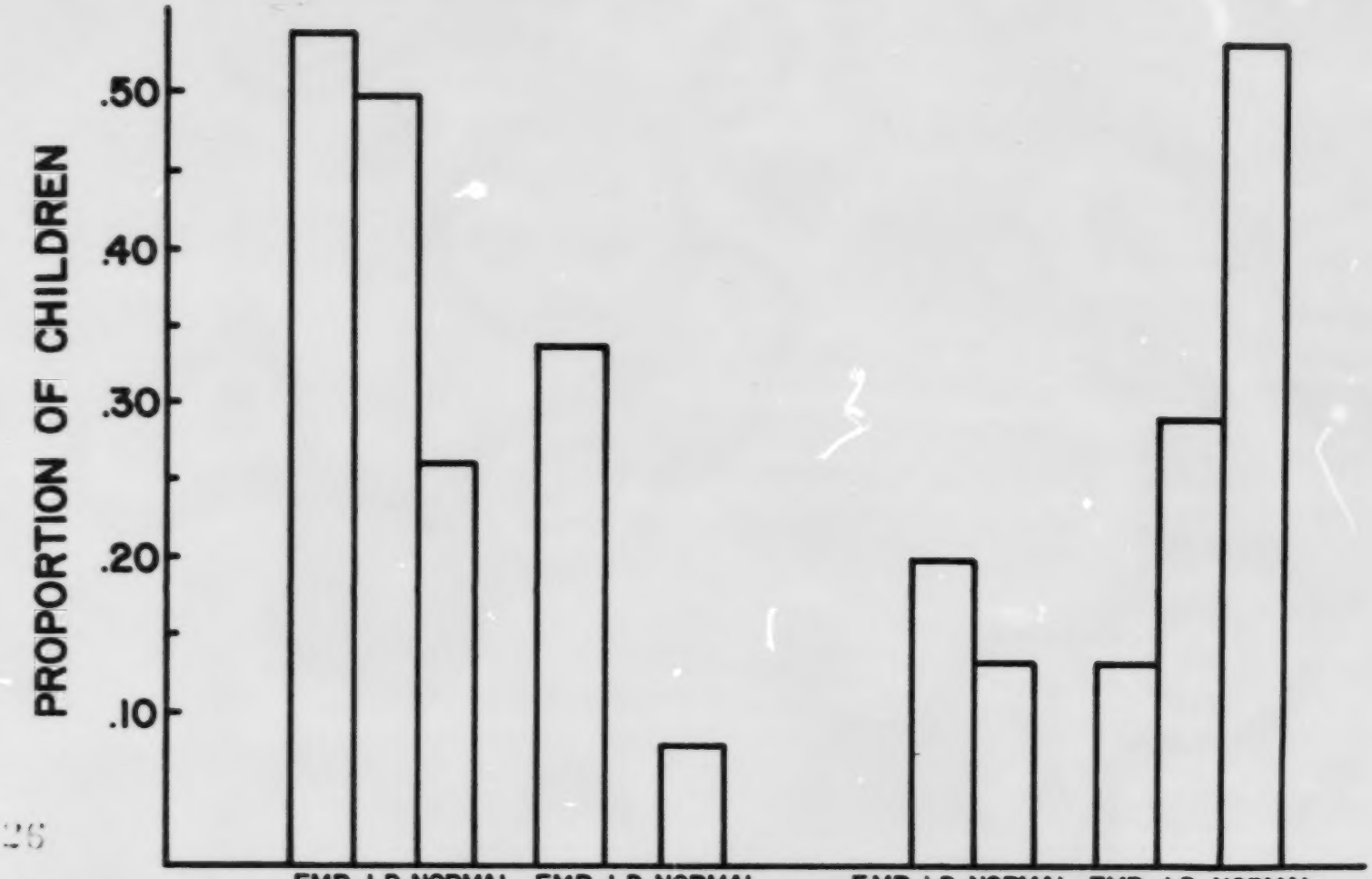

LEARNING/ TRANSFER PROFILES